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The Illinois Chemistry Teacher

A Journal of

THE ILLINOIS ASSOCIATION OF CHEMISTRY TEACHERS

Volume II | NOVEMBER, 1935 | Number 2

Training Physical Science Teachers

J. H. REEDY

Professor of Chemistry, University of Illinois

The relation of high school chemistry and physics to the college courses is what might be called a "perennial subject." I do not recall a teachers' conference that I have attended where this subject, in some form, was not up for consideration. Its discussion seems to have become a ritual. We meet once a year and pledge our allegiance to certain academic ideals, and then go home and try to live up to them—that is, more or less.

The requirement of college training for teachers of high school sciences has been frequently attacked. There are some who contend that no college courses should be required at all. High school texts are ample, and all that is necessary is that the teacher should be able to follow them intelligently. The reply to this is immediately forthcoming. If high school chemistry is to be a preparation for college work, it is highly desirable that the teacher should know just what his students are being prepared for. On the other hand, it is argued, college courses differ with different institutions. For which one should the student be pointed? In reply I should say, no one in particular. All too often the high school teacher loses sight of the objective in high school chemistry. He tries to anticipate the college course by giving college work in high school, but with reduced thoroughness and vigor. His sole idea seems to be that his students should make good records in college. As should be expected, students trained in this way frequently make poor showings in college. All the novelty and freshness of the latter course has been sacrificed. I believe, very firmly, that the high school course should not be an undersized college course; on the other hand, it should be organized along other lines, with objectives that are quite different. I think that the fundamental purpose of the high school course should be to give the student accurate and scientific information about the contact of chemistry with modern industrial life. Now how does college training help in such a course? In many places. The teacher should know the fundamenal theories of his science, so that he can think straight and make no mistakes in explaining processes to his class. It is simply the old dictum, that a teacher must know more than he teaches.

Next, the question comes up, cannot the teacher obtain this background of chemical information in other ways than attending college? Books and other forms of literature are available, and the earnest teacher should have no trouble in employing his time profitably. But, as all of us know, isolation is seldom productive of scholarship. A man in college, taking advantage of the facilities of class room, laboratory and library, develops much faster than the individual worker.

A further objection to placing an untrained man in charge of a course is that he is almost sure to develop a limited perspective. Topics that particularly in-

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THE ILLINOIS CHEMISTRY TEACHER

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ONE GOOD TURN

Each time we pay the expense of publishing an issue of this Journal we become more impressed with the wholehearted cooperation and interest shown by our advertisers. A glance back over the previous issues will show how consistent they are. We are pleased to welcome new advertisers to our group for it is largely the advertisers that meet the expense of this publication. We would like for them to know that the readers of "The Illinois Chemistry Teacher" read their advertisements and appreciate their support. The easiest way to do it is to mention this Journal when you send them your order for the usual goods you buy. Should you wish to send them a brief note separately, they would appreciate that too. We have met the managers and advertising agents of nearly all these companies and have found them to be people quite friendly to the work of our Association and people you would like to know and do business with.

THE URBANA CONFERENCE

The coming High School Conference at Urbana affords Illinois science teachers another opportunity of meeting together, getting acquainted, and at the same time profiting from a well-balanced program. Undoubtedly both Allen R. Moore of Ciero and H. P. Leighly of Rantoul have spent considerable effort in planning the program and are to be complimented on their good work. However we must not forget the work of Glen Tilbury of Urbana in arranging our regular luncheon. There seems to be no substitute for eating together as a means of "breaking the ice," getting people acquainted and fostering the spirit of friendliness. As we are all anxious to meet more of our fellow teachers and get better acquainted, why not make it a point to do so at the luncheon. Quite often the contacts we make at a meeting such as this are of as much professional value as what we get from the regular program. So let us all plan for the luncheon together at Newman Hall and make it an even greater occasion than that of last year.

Dr. W. A. NOYES HONORED

The Priestley Medal, awarded by the American Chemical Society for oustanding achievement in chemistry, went this year to Dr. William Alfred Noyes, whose work on determining the atomic weight of chlorine, studies of camphor and its derivatives, and contributions to the electrochemical theory of valence (the bonds by which atoms are held together in chemical conpounds) called forth the signal commendation of his colleagues. Doctor Noyes is seventy-seven, a short, thin man pedagogical in manner. Following the War he became intensely interested in peace movements, published a series of pamphlets at his own expense urging scientists to take the lead in bringing about world amity.

Last week, responding to the award of the Priestley Medal, he declared:

"The two outstanding problems to be solved by our generation are the abolition of war and a better distribution of the products of our industries." 1

1 Literary Digest 120:16 August 31, 1935

IS SCIENCE SERVING THE MASSES

When we note the relatively small number of students in high school that select science as a major and particularly the few enrolling in the physical sciences, we raise the question of what is wrong in science education. Science principles and applications, factual relationships, and understandings are just as interesting, far more challenging, and often more closely related to the life of the student than much of what he otherwise studies. Students are not prejudiced against it. They admire the achievements of science in the industrial field and talk about them. But they fail to elect a science course because they do not recognize its value to themselves. Quite often their judgment is based upon the experience of a friend who has taken the science course. The friend may have been one of those average individuals for whom the course may not have been designed and who consequently did not get enough value or satisfaction from it to recommend it highly to his fellows.

Is is true that science as generally taught does not meet the needs of the masses? Surely chemistry, for example, is not just for the student who intends to speciallize in science in college or is aiming at a profession requiring a knowledge of chemistry such as medicine or dentistry. It would scarcely be justified on this basis in many schools as so few are in this group. Chemistry can offer great values, both practical and cultural, to every individual. The 90% who do not take chemistry in college are entitled to consideration and should also be served according to their needs. Fortunately educators are beginning to recognize the science needs of the great mass of high school students and are emphasizing greater life values. The shortcomings of the teacher training work are being noted and better professional courses are being developed. Is is obvious that teachers of science who have received all their training in college courses designed to meet the needs of industry or research workers in the science field are distinctly handicapped when they in turn attempt to teach a high school group of varying interests, 95% of whom will not take a college course in that subject. As teachers are apt to teach somewhat as they have been taught, they are likely to fail with such a background of training to interest the average high school student. More professional courses are needed that have been developed by teachers in close contact with the high school field. Every step in this direction, whether in college or university, should receive the hearty endorsement of every science teacher.

REDUCING COSTS OF SCIENCE SUPPLIES

As science teachers we have been faced for several years with the problem of making a very limited sum of money buy all the supplies for our departments. While we are still interested in lower costs it seems appropriate to note some of the ways in which we could cooperate to lower them.

It is doubful if many of us recognize the needless expense we place upon supply companies, expense which in turn must be added to the cost of goods which all must buy. For example, if orders are made out carefully from a catalog with the catalog number and exact specifications, the company can in a short time estimate the cost. Even the competing companies can more easily bid on the same order as they keep at hand their own corresponding numbers for similar items. The saving in time for the company means a saving in cost which when totaled for all orders represents a considerable sum.

The cost of handling each order and routing it through the plant is no small item. It is for this reason that orders for less than one hundred dollars should not be divided among two or more supply companies. When such orders are divided among five or six companies, as frequently happens, the cost of handling is so out of proportion to the actual cost of the goods that the cost of science supplies in general is necessarily increased.

JOHN C. CHIDDIX.

TEACHERS PROTECTIVE ASSOCIATION

The following facts submitted by Mr. E. W. Powers of Bloomington, who is executive secretary of the recently organized Illinois Teachers Protective Association, indicates a new trend in teacher activity and one to be highly commended. The saving through cooperative buying of such services as are indicated is quite substantial and reflects much credit upon those who have given of their time and energy for our mutual advantage. The Editor.

The Illinois Teachers Protective Association, a non-profit corporation, has been organized with the purpose of procuring for its members from various insurance companies, all kinds of protective services by means of group bargaining. In many cases a large association can get group discounts—in all cases the patterns of policies will be adapted to teacher needs, and the time of payments made to suit teacher convenience. Services to be included are pension-annuities in flexible units of various sizes, hospitalization funds, last illness and burial funds, all the standard forms of life insurance, auto insurance, and fire insurance. Furthermore, the association aims to foster credit unions, promote movements for increased state pensions for teachers, longer tenure for teachers, and improved conditions in general for teachers wherever and whenever their influence can be effective.

The studies of Mr. Grimm, Research Director under direction of Secretary R. C. Moore and an Insurance Committee of the Illinois State Teachers Association, the reports of Superintendents Melton, Jordan and Loos in the City Superintendent Association on insurance have been relied upon for underlying data. The experience of Protective Service Divisions of State Teachers Associations outside of Illinois has been drawn upon.

Annual dues for those belonging to the Illinois State Teachers Association are $1, for others $1.50, but membership is limited to those engaged in educational work. This permits lower prices in those cases where teachers are a preferred risk. Teacher representatives elected by fellow members or recommended by Superintendents, Principals or Club and Federation Officers will present these services to their colleagues at small fees—thus lowering acquisition costs.

The officers are as follows: president Monroe Melton, superintendent of schools, Normal, Illinois; vice president, William Harris, superintendent of schools, Decatur, Illinois; E. W. Powers, executive secretary, formerlly superintendent of schools at Fairbury, Watseka and Petersburg; superintendent V. L. Nickell of Champaign, Illinois and Ray Graham of Mason City. These officers will serve as the first directors and apply for a Charter.

An Advisory Board of at least 20 members, preferably more, will advise as to general policies, types of service, modes of presenting the same; in fact they will advise along any line they deem important. This Advisory Board which is not yet completed, includes officers of The Illinois State Teachers Association, Division Officers, Faculty Members from the University of Illinois, Superintendents, Principals, Classroom Teachers and County Superintendents. Some 20 of these educational leaders have already written their consent to serve. A list will be published soon when more of the territory is represented. At present the organization is centerd in central and northcentral Illinois. About 500 mmbers were enrolled in the East-central Division at the Champaign meeting of October 11. This Division also adopted the following resolution:

That this Division endorse the Illinois Teachers Protective Association, a non-profit organization, officered and advised by school men and women, which seeks to secure for teachers on a preferred basis all kinds of protective services, by means of group bargaining: and we recommend the Illinois State Teachers Association give this protective Association endorsement and support.

Insurance as a safe investment has rapidly grown in favor with the public which during the past five years has learned some expensive lessons.

Using Numerical Problems

CHARLES GOODING

Champaign High School Champaign, Illinois

The numerical problem is not given its due credit for excellent educational value. In the hurry of supervising one hundred or more chemistry students, preparing for laboratory and demonstrations, checking notes and reports, and grading quizzes, we are apt to neglect the usefullness of a properly selected set of problems. A habitual program requires time both to prepare and to grade, but I believe that in clinching facts, in training in methodical thinking, in developing an ability to follow through a line of reasoning, they are without a peer as an educational tool. Their efficiency, though, depends on their method of use. It is the habitual weekly program that counts. Merely to state that tomorrow take the five problems at the close of the chapter will probably be time wasted. The program must be definite and must be one you know the student can accomplish.

Nearly thirty years ago, one of our great American teachers said "The working of problems in considerable numbers by individual students seems to be an exercise too often neglected. This is acknowledged to be a valuable aid in enforcing the quantitative character of every chemical change, and in holding the pupil's attention on, and making him familiar with combining weights and their use. More difficult problems, concerned with the calculation of molecular and atomic weights, and other allied subjects, using the laws of gases, form the readiest means of clinching what may otherwise remain a mass of loose and ephemeral ideas. Sample cases should be worked in the class room. After the pupil's exercises have been corrected, it will be found advisable to discuss them with the class." This is just as true now as when Alexander Smith stated it in 1904.

An article which I think very apropos appeared in the Journal of Chemical Education for August, 1933. This article was entitled "The Characteristics of the Ideal Numercial Problem," by Alex C. Burr, of the Massachusetts Institute of Technology. What we may expect to accomplish by the skillful use of this device Dr. Burr describes in his article. First, he says, "To illustrate, fix in mind, and make quantitative principles and methods treated in lecture and in text. Second, to test effectively and conveniently a student's knowledge of the subject and grasp of essential points. Third, to encourage logical thinking and methodical procedure on the part of the student. Fourth, to give the student practice in handling and criticizing experimental data." I think problem solving is the best training for that thing we call reasoning, if that be capable of being trained. Our educational processes seem to be based so much on fact acquiring and not fact using, thus putting such a load on the memory. Then we test to see how much has been forgotten. If the student can solve problems, we may be sure that some of the information has been assimilated and facts are being used. When there is an opportunity to get away from mere memory processes in chemistry we should do so, for so much of the work has to be done by memory.

For high school work I do not like to use mathematical formulas if that can be avoided, in the solving of problems. I think it better to show the reasons for each step, then let student work out the problem himself. It seems to me there is nothing especially gained in substituting numerical data for letters in a formula, then doing the indicated arithmetic, unless the student be taught how to derive the formula.

In taking up a new type of problem we should have an intensive drill till we are certain every student has had full opportunity to understand the fundamentals of this type, then give carefully selected sets for home work. When returned they may be passed around for class grading, explained by some capable student or the instructor, then turned in for final checking by the instructor. This class correction should not take over ten

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Chemistry Museum Displays

WALTER E. HAUSWALD

Sycamore Township High School Sycamore, Illinois

In presenting the subject of "Chemistry Museum Displays," it is assumed that the majority of elementary chemistry teachers are interested in newer means or devices for making the high school students' first meeting with chemistry a more pleasant and profitable experience. It is to such teachers who have been searching for further means of vitalizing the subject matter of chemistry that the following remarks are directed.

For the past several years the opinion of authorities in the field of chemical education has been that there is a great danger of high school chemistry becoming too highly technical, with insufficient emphasis being placed upon the acquisition of knowledge which may prove useful to the majority of the students. We are guilty, (to a certain degree) of "cramming" an enormous amount of chemical theory into the minds of our unfortunate students in a desperate attempt to make chemists out of them all.

There is no lack of evidence to show that this attitude is not justified by existing conditions and that the college preparatory objective is unworthy of the attention it has been receiving. One investigation has shown that less than one high school chemistry student in four will ever continue his study of chemistry in college and only five in a hundred will take two years of college chemistry. From this data it appears that a good share of our teaching has been misdirected and that we must give more attention to the adaptation of our instruction to the needs of the 75- 95% who do not expect to continue the study of chemistry in college.

It is my firm belief that the elementary high school course should be so arranged that the student will be given valuable training in the ability to appreciate the contribution of chemistry to modern civilization, and a store of information that will be of some functional value when he has finished, whether he continues in college or not.

With this thought in mind a plan was undertaken in the chemistry department of the Beardstown, Illinois High School, which has to a surprising degree stimulated interest and apparently brought about a more keen appreciation of the contributions of chemistry to our present mode of living.

In brief, the plan consisted of arranging and presenting a series of displays of chemical materials and products in an order paralleling that in which the various materials were discussed in the organization of the course. In setting up this plan, the first problem was to determine the subjects upon which these museum displays could be made. To solve this problem a comittee of several students was appointed to draw up a list of chemical subjects which would lend themselves to this type of work.

A second problem was that of securing materials for use in the displays. Many samples of the elements, compounds and manufactured products used in the displays could either be found in the laboratory store room, or purchased at local retail stores. However, in some cases it was necessary to write to several manufacturers who very kindly cooperated by supplying samples of raw materials and certain of their finished products.

A third problem was the construction of a suitable show case. Two boys interested in woodworking were assigned the task of drawing plans and in a short time had prepared a suitable display case triangular in shape and designed to stand on a corner notebook rack at a height of about 36 inches. Several scraps of white pine and two pieces of discarded window glass served as the chief materials. The following dimensions will serve to indicate the approximate size of the completed case: heighth at rear, 12 inches; front, 8 inches; length of sides, 25 inches; and front, 37 inches. The completed case was painted inside with flat white paint and fin-

ished on the outside in harmony with the dark woodwork of the room. Since the corner of the room did not receive a great deal of natural light an electrical lighting system was incorporated into the design of the case. This consisted of four six-volt automobile bulbs mounted in a trough-shaped reflector of bright red tin plate and fastened to the underside of the wooden strip used to hold the top and front pieces of glass in place. While this display case has served quite well in this one instance it is to be understood that the design might well be altered to suit the available room space and any other controlling factors.

The report of the committee chosen to select subjects for displays indicated a little more than thirty different subjects had some possibilities. From this report a list of twenty-five was chosen and a schedule arranged so that a separate and distinct display could be presented each of the last twenty-five weeks of the school year.

Teams of two students each were made responsible for procuring and arranging all materials for each display, and on the day of presentation one student was given an opportunity to make a short talk before the class—pointing out the most interesting features of the display.

The actual arrangement of materials within the display required careful thought and planning. In many cases powdered or crystalline materials were used; and, in order that these substances might be shown to the best advantage, they were placed in small conical piles on paper of contrasting color, cut in approximately two inch squares. Small clear-glass specimen bottles were obtained from a chemical supply house and used as containers for the various liquid samples on display. The names of the various materials used in the exhibit were printed in India ink on small white cards cut to uniform size and folded so that the printed surface was held upright. These cards were placed next to the materials as a means of identification.

The following are a few of the subjects used during last school year:

Sodium and Potassium and their compounds, Sulfur and Its Uses, Nitrogen and Nitrogen Compounds, The Phosphorus Family, The Halogen Family, Free Carbon, Combined Carbon, Fuels, Petroleum Refining, Calcium and Its Compounds, Linoleum, Aluminum, Ceramics, Cement, Glass, Leather, Bakelite, Iron and Steel, Alloys, Products from Corn, Textiles, Pulp and Paper Production, Paint and Varnish, Oxides, and Carborundum.

Near the close of the school year several students suggested that these displays all be set up at one time as an exhibit of the work of the chemistry department. To do this it became necessary to make a wall-board model of the display case for each subject in the exhibit. Several boys went at the task and in a short time turned out twenty-five exact models of the original case. Some of these were painted black and others white; the white being more satisfactory for displaying black and darker colored materials.

Several students interested in photography suggested that these display models be photographed and preserved as a record of their work.

Some of the apparent worthwhile outcomes of this student activity are:

First: Small groups of students are given the opportunity of discussing and working with actual chemical materials.

Second: If properly organized, this activity may offer a motivating influence and at the same time provide for the individual differences in the abilities and interests of the students.

Third: To set up accurate displays requires that the student read widely concerning some special phase of chemistry, which gives valuable training in the use of reference materials; and serves to enlarge the reading tastes of the individual.

Fourth: Valuable information is presented in a visual manner which undoubtedly contributes to the students' appreciation of chemistry.

Fifth: This activity serves as a means of bringing the chemistry course to the attention of the student body and the community, and in that way remove much of the mystery usually associated with the subject.

PHYSICAL SCIENCE PROGRAM

HIGH SCHOOL CONFERENCE—UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS

Friday, November 22, 1935

GENERAL SESSION, 9:00 A. M., Physics Buiding

Chairman — Allen R. Moore, Director of Natural Sciences
J. Sterling Morton High School, Cicero, Illinois

9:00 Some Contributions of Chemistry and Physics to Aviation — Major Walter K. Burgess, U. S. Army Air Corps, Rantoul, Illinois

9:50 Nuclear Physics—R. F. Paton, Associate Professor of Physics, University of Illinois

10:50 Some Practical Suggestions for the Teaching of Physical Sciences — Francis D. Curtis, Professor of Secondary Education and the Teaching of Science, University of Michigan

11:30 Round Table Discussion, led by Professor Francis D. Curtis

Luncheon, 12:15 Noon, Newman Hall, 602 East Armory Street
Arranged for members of Illinois Association of Chemistry Teachers
(See note below concerning reservations)

CHEMISTRY SESSION, 2:00 P. M., Physics Building

Held in conjunction with the Illinois Association of Chemistry Teachers
Chairman — H. P. Leighly, Rantoul Township High School, Rantoul, Illinois

2:00 Class Participation Exercises vs. Individual Laboratory Experiments in High School Chemistry—Thomas M. Barger, Illinois State Normal University High School, Normal, Illinois

2:50 Aims and Activities of the Illinois Association of Chemistry Teachers,—Professor Howard W. Adams, Illinois State Normal University, Normal, Ill.

3:00 Suppementary Materials for Enriching High School Chemistry, — Walter E. Hauswald, Sycamore Community High School, Sycamore, Illinois

3:10 Liquid Ammonia as a Reaction Medium (demonstration),—Dr. L. F. Audrieth, University of Illinois, Urbana, Illinois

(Note: Reservations should be made in advance by writing Mr. Glen Tibury, Urbana High School, Urbana, Illinois. The cost is 45 cents per plate. To go to Newman Hall for the luncheon, from the physics building, go west one block to the stop light, then four blocks south to library, then west one block.)

Dues — you may become an active member of the Illinois Association of Chemistry Teachers by sending your 50 cents to the Secretary-Treasurer, Mr. H. L. Slichenmyer, Bloomington High School, Bloomington, Illinois. It is easier to mail one dollar and pay your dues for two years as several are now doing. BE AN ACTIVE MEMBER.

Training Physical Science Teachers — Reedy

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terest him will be stressed more or less unconciously. I know a man, trained as an agricultural chemist, who was placed in charge of a high school course in chemistry. He favored his hobby, and his students learned almost nothing but "barnyard chemistry." I have heard of a photographer who turned chemistry teacher. As might have been expected, his teaching lay mainly in the field of photo-chemistry, and while his students

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USING NUMERICAL PROBLEMS

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minutes and in the majority of cases it will be honest. It is true that students may help each other in home work, so that the paper turned in may not be the product of the student whose name is signed to it, but the unreliable student will sooner or later be detected in problem quizzes. One day each week should be regarded as problem day, when the major emphasis should be on problems, for-

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Champion Sillimanite Laboratory Ware

Lasts Longer

SILLIMANITE or Mullite laboratory ceramic ware differs from "ordinary" chemical porcelain ware in composition, since all of the quartz and part of the clay are replaced by one of the Sillimanite minerals. This replacement of quartz with a substance that possesses a constancy in volume on heating, produces a ware having high resistance to breakage from heat or mechanical shock. Fatigue is practically absent. Other desirable characteristics, such as greater thermal conductivity, higher melting point of the body, greater chemical inertness of the body, and a greater uniformity in the shape of the resulting articles, are attained by the replacement of quartz with the Sillimanite mineral.

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Sillimanite chemical laboratory ware in all the usual sizes and shapes familiar to the chemical laboratory is manufactured to sell at the same prices that have been established for the best grade of chemical porcelain. We believe that the opportunity to purchase a superior product at no greater price is one to be accepted as a real bargain opportunity.

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Training Physical Science Teachers — Reedy

(Continued from page 8)

learned much about the technique of developing, fixing and printing, they learned next to nothing about valence, formula making, reactions, and so forth. College training goes far to eliminate this unfortunate individualism upon the part of the instructors by standardizing the training of teachers by giving them more or less identical training.

It is frequently charged against college-trained teachers that they know too much; that they have impossible ideals in their teaching. Such criticism is sometimes just. I recall a case where a teacher spent his "year off" in a large university studying physical chemistry, and on his return he tried to visit his new attainments on his students, with very doubtful success. I presume that there are many similar cases, for they usually arise from a frailty that is distinctly human. But may I insist that the trouble is not due to the teacher knowing too much; rather it is due to a lack of proper appreciation of values, or in some cases to an inflated ego. Such teachers are not necessarily ruined by advanced work. What they need is to be called into the office of the principal, where the latter should, in a very kindly but positive fashion, remind the teacher of such things as objectives and limitations in high school teaching. If this is not sufficient, a change should be made. Advice from a wise principal has saved many an ambitious young teacher, who afterwards found that his advanced work helped him to "understand what he knew about a subject," and thereby make his classroom work clearer and easier. In cases where a young teacher persists in parading his erudition, I doubt if he was ever a real teacher, even before he made his foray into advanced work. Something is lacking in his makeup, and sooner or later he will develop a temperament and disqualify himself in some other way. Perhaps these precocious youngsters should be promoted into college work where, as some would have us believe, an abnormal ego and a bounding temperament are the prime qualifications for professional rank.

The present requirements for physics and chemistry teachers in the State of Illinois is 16 semester hours in physical science, 8 of which must be in the course taught. For chemistry teachers this requirement is usually met by a two-semester course in general chemistry. I hold that such a course should be required in all cases. This is necessary to provide adequate training in valence, reactions, and the simpler calculations of the science. A single semester is not sufficient, for that would provide no training in the metallic elements which constitute a large part of the high school course. Judging from the average student taking the Freshman course at the University of Illinois, I think that this may be accepted as a minimum, but by no means ideal requirement. In several cases I have declined to write letters of recommendation for teaching positions for students who have made satisfactory marks in general chemistry, for I felt that they did not know enough to teach the subject satisfactorily. I can easily believe that teachers with no more than eight semester-hours of college chemistry are "in hot water" most of the time. They may try to "bluff by," but high school students are far too bright not to spot a bluffer, and the teacher's usefulness is seriously impaired. Next to a course in general chemistry, I would urge a course in college physics, so as to familiarize the teacher with the behavior of gases, heat, electricity, and so forth. In addition to these I think a course in qualitative analysis is desirable, not only to enable the teacher to handle the numerous unknowns referred to him, but especially for the drill in reactions which such a course affords. I also suggest a survey course in organic chemistry, for this subject is becoming more and more important in the field of applied chemistry. If I may add another chemistry course, I would make it a course in industrial chemistry, for the sake of the insight it gives into the utilitarian side of chemistry.

It may be outside of the scope of the subject assigned to me, but there is another minimum requirement in high school chemistry that I want to mention. That is laboratory equipment. The other day I heard of an accredited high school.

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"That's a Real Workbook, Not a 'Busybook'

The Best That Has Ever Been Done"

Thus commented a chemistry instructor on examination of the new **Chemistry Workbook** by Charles E. Dull. And the orders came in faster than the comments. Prepared by a master hand in the field of high school teaching, **Chemistry Workbook** and **Physics Workbook,** both new this year, made a definite and immediate appeal as is evidenced by the following schools, in Illinois alone, which ordered either or both these titles.

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Aurora
East High School
West High School
Barrington
Belvidere
Bensenville
Bloomington
Bluffs
Blue Island
Bushnell
Canton
Carbondale
Carthage
Carmi
Champaign
Chicago
Calumet High School
Crane Tech. High School
Hirsch High School
Kelvyn Park High School
Phillips High School
St. Leo High School
DePaul Academy
Chicago Heights
Cicero
Coal City
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Freeport
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Granite City
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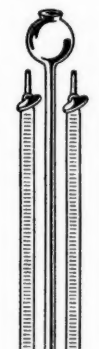

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USING NUMERICAL PROBLEMS

Charles Gooding

(Continued from page 8)

mulas and equations. Part of the laboratory time may well be spent in these exercises. Assignments should be mimeographed if possible; if not, they should be placed on the board for students to copy. I want to repeat again that to be valuable problem solving should be a regular part of the teaching program, and should last throughout most of the year, no matter what topic is being studied.

The teacher should build up a collection of problems which he knows will fit. Too much reliance should not be placed on the textbooks as in many cases it does not seem to be well adapted to the subject being studied at that time. Plenty of material may be found in regular problem books in supplementary text books, in the text book being used, or the problems may be made. A large list of problems should be accumulated and filed in a suitable note book along with plenty of equations and formulas. The problems should be catalogued into various types to comply with the principles to be illustrated. The first type is the well known gas correction form, using th laws of Charles and Boyle. If the pupil understands the laws it should not be difficult for him to see that by arranging the temperature and pressure corrections as fractions he can get his corrected volume greater or less than the given volume in accordance with the law. For example, if the gas be heated, he expects a larger volume according to Charles' Law, therefore puts the larger absolute temperature above the line in the fraction and the smaller absolute temperature below. In multiplying this will give the answer greater than the given volume. Boyles law states if the pressue be decreased the volume is increased, so here the student

also puts the larger barometric pressure above the line. Why water vapor pressure should be subtracted from the barometer pressure should be explained.

Next, the study of atomic and molecular weights, the main idea is the actual weight relation between the elements, atomic weights being ratios which may be expressed in grams or other weight units, the arithmetical figures being the same. The mole should be emphasized. In the third type the peculiarities of gases are especially brought out, with Gay Lussac's law and Avogadro's explanation. The gram molecular volume should be made clear to the students, using a box if necessary, and if possible make the students understand that the formula weight of any gas in grams will just fill this box under standard conditions. Data based on Victor Meyer's or Dumas' experiments should be used as the basis for many problems. These two should be the subject of a demonstration talk, which should make the problem much easier to comprehend. Also here vapor density should be taken up and also specific gravity problems if they are to be studied at all.

We should be well down in the first semester by this time and have done considerable work on equations. Weight relations should be easy to understand and usually give little trouble to most students. Volume from weight is more difficult, but if the concept of the G. M. V. has been put across so it sticks, there should be no insuperable difficulty here either.

During the second semester there should be more drill on the equation type with the major part of the emphasis on equations and formulas, occassionally having problems of each type so none will be forgotten.

If a carefully thought out program of problems can be followed throughoutt most of the year I believe our teaching will gain in logical presentation and result in clearer thinking and a more permanent retention of the important facts.

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Training Physical Science Teachers — Reedy

(Continued from page 10)

in which the laboratory equipment consisted of a table, a kitchen sink, and a few bottles donated by a neighborhood drug store. With the aid of alcohol lamps the students were trying a few experiments, though necessarily omitting some of the work generally required in high school courses. In such cases as this, I really feel that the school should drop chemistry from its program until it is able to give it efficiently. Another unfortunate situation has come to my attention. In one of the larger towns of the state, the school board made no appropriation for chemistry supplies. The teachers were told that they would have to get along on such supplies as were left over from last year. As might be expected, the laboratory was short on such indispensable reagents as the common acids and most of the commonly used salts. The teachers planned to ask each of the students to contribute 50 cents or more toward a fund to buy the necessary supplies. I have not heard how well the scheme has worked out, but I doubt if much money was raised in this way. Again I raise the question, should not this school discontinue its work in chemistry until it can do it in an acceptable way?

I think that I am fully sympathetic toward schools that have been hit by the depression. Still I do not feel that hard times constitutes sufficient reason for lowering educational standards. Whatever we do, let it be firstclass. The educational leaders of Illinois worked for years to bring our schools up to their present excellence, and all this advance can be wiped out in a single year by lowering our standards of high school preparation. If the budget of a school is not suffcient to continue the program of previous years, curtail the program, and not the standards of scholarship. Most of our high schools offer courses for more than the requisite 16 units required for entrance into college, and such schools should effect the required saving by omitting such subjects as may be indicated by low registration and poor facilities for instruction.

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